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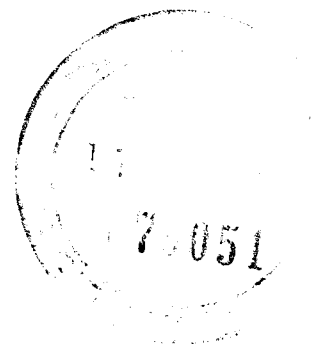
STRATEGIES OTHER THAN BREEDING FOR THE DEVELOPMENT OF SMALL RUMINANTS



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*Paper presented at the IDRC/SR-CRSP/ACIAR Workshop on Small Ruminant Production Systems, Bogor, Indonesia, 6th - 10th October, 1986.

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ABSTRACT

The paper discusses strategies other than breeding that are important to the development of, and contribution from, small ruminants. These include inter alia precise production objectives, choice of species, reproductive efficiency, feeding and nutrition, exploring the avenues of production and the components of infrastructure, research, linkages and training. The choice of species for a particular production system is determined by such factors as the availability and quality of feed resources, feeding behaviour, availability of animals, survivability, relative price of meats, market outlets and biomass production. The principal strategy should be to make maximum use of the available feeds and improved efficiency in feeding and nutrition, in which increased use of crop residues and agro-industrial by-products, dietary nitrogen sources and strategic use of supplementary protein sources are especially important. Where possible, fodder production needs to be increased to sustain all the year round feeding. Of the avenues of production, the highest priority should be directed to systems integrated with tree cropping, followed by intensive stall feeding systems that can make more use of the large reservoir of fibrous feeds. The availability of 20.3 million ha presently under permanent tree crops is underutilised, and it is estimated that this area can support an additional 81 million goats or sheep. Attention is also drawn to the need for urgent initiative to capture the large market potential for goat meat and mutton in the Near East region commensurate with more intensive stall feeding systems of production. Potential possibilities of how further improvements can be achieved are discussed which can make a significant impact on correcting the existing and widening gap between production and consumption of food supply from small ruminants.

I INTRODUCTION

Two previous papers in this Workshop have discussed the types of prevailing production system in South and South East Asia, the constraints that currently exist (Devendra, 1986a) and the breeding strategies that need to be pursued within these systems (Bradford et al., 1986).

In order to complement both these papers, it is relevant to consider all other aspects of development that concern the future of goats and sheep. This paper will focus on those strategies other than breeding that are important to the development of, and contribution from, both species. Such strategies have also been previously discussed (Devendra 1980; Devendra, 1985a).

In general, it is especially important in seeking high efficiency in feeding systems and productivity for a specific situation to maintain an appropriate species, to aim for a realistic potential level of production, to take advantage of the available dietary ingredients and identify the objectives clearly in terms of production and profitability. In this, it is particularly important to understand the particular abilities of each species, their feeding behaviour, response within individual environments and potential productivity in the context of efficient utilisation of the production resources.

II PRODUCTION OBJECTIVES

It is essential to have clear production objectives. Without these, it is not possible to maximise productivity from both species as well as ensure complete utilisation of the goat and sheep genetic resources. It is also imperative to relate the production objectives to the available production resources, prevailing market demand, consumer preferences and the marketing strategies that may be required

to link up with the market outlets. The following considerations are pertinent, adapted from Turner (1972) :

Characteristics of the Products

(i) Meat (goat meat and mutton)

Quantity - Total amount of lean meat in the carcass (measured by live weight before slaughter). Growth rate, in the case of lambs, is related to efficiency of production. Total number of animals available for slaughter; this is likely to be more important than amount of meat in each animal.
Total weight of offspring weaned/year/female is important.

Quality - Quantity and distribution of fat (excess undesirable). Taste factors.

(ii) Milk

Quantity - Total yield, lactation, length, persistency and number of lactations.

Quality - Milk composition (butter fat and solids non-fat).

(iii) Carpet Wool

Quantity - Clean wool per head.

Quality - Average fibre diameter (coarse fibre desirable). Presence of a proportion of medullated fibres (hair). Absence (or a very small proportion) of kemp (shed fibres, or ones with the medulla occupying 90% of the diameter). Staple length. Percentage of clean scoured yield.

It is emphasised that throughout the Asian region, goat meat and mutton are in very high demand. The demand for both outweighs supplies and this is reflected in high prices of especially goat meat, and increased imports of mutton from Australia and New Zealand.

III CHOICE OF SPECIES

The choice of species and indeed breeds within a species is determined by several factors :

The following factors are relevant:

(i) Availability and quality of feed resources
(ii) Feeding behaviour
(iii) Availability of animals
(iv) Survivability
(v) Relative price of meats
(vi) Market outlets for meats
(vii) Biomass production

A consideration of appropriate species is important in relation to the resources available, the environment and the market demand for specific products. In general, intensive systems will be influenced by the availability and quality of forage, and in turn, the choice of anyone species. With the more extensive systems, both species are often herded together, and a higher proportion in these mixed herds is an indication of superior survivability by goats, and that ability to cope with feed shortages.

While the husbandry of goats and sheep is complementary, both species have some distinctive characteristics. It is important that these features are recognised in the choice of animals appropriate to individual production systems. Both species are often run together in traditional management systems, but where there is a specific demand for products from one or the other species or when the prevailing situation favours a particular species, an appropriate choice is therefore realistic. Goats however, favour drier conditions and where there is abundant browse. Sheep, by virtue of their less inquisitive habits are perhaps more suited to situations where there is more herbage for grazing.

Unlike the semi-arid and arid regions where multi-species (sheep, goats, camels, but rarely cattle) are reared together in essentially nomadic and transhumant pastoralist sytems, the situation in humid

tropical Asia is different. Here goats and sheep are run together, and use of both species is a distinct possibility for both practical and economic reasons. In very arid environments however, goats tend to survive longest under the extreme climatic conditions and under deteriorating feeding conditions.

In terms of meat production, the question of whether the number of kids or lambs born, and the amount of meat which can be sold annually from the breeding flock is a very real issue affecting the choice of species. This is also influenced by the relative price of meats and also the market demand for the product. Biomass production is dictated by age a number of biological factors and include age at first breeding, interval between parturitions, litter size, lifetime productivity and mortality.

IV REPRODUCTIVE EFFICIENCY

The task of maximising numbers and ensuring survival is a particularly important strategy to increase productivity from both species. It is also an important component of producing numbers for both breeding as well as marketing reasons.

Thus improvements to reproductive efficiency can significantly influence the objective of increasing numbers born and the output of products. Reproductive rate is the all too important factor and the build up of numbers is associated with the following components :

(i) Age at first mating (females)
(ii) Productive life span of males and females
(iii) Annual mortality in the breeding flock
(iv) Number of young female reared per 100 breeding females. This is influenced in turn by :
    a) Percent of breeding females failing to bear
    b) Percent of breeding females producing multiple births
    c) Frequency of parturition, and
    d) Mortality rate up to first mating

Based on the breeds available reported by Devendra (1986), there are at least four breeds each of goats and also of sheep that are

distinctly prolific. Very much more use can be made of all these breeds to increase the contribution from both species.

Increasing fertility or number of offspring born per female per kidding or lambing is important because this influences significantly the margin of profits. This point was demonstrated in calculations with 80, 100, 120 and 140% rates of fertility for goats in Malaysia. The gross margin of profit increased with fertility level, type of feeding system, per flock or per breeding doe (Devendra, 1976). Lifetime productivity is essential and females must be retained in the flock long enough (5-7 years of age) in order to express their genetic capacity.

The significance of varying litter size due to inherent genetic capacity is reflected in a comparison between goats and sheep in Malaysia in terms of biomass production. Biomass production is the net effect of combining the inherent biological qualities in the species as well as good husbandry. It is influenced by such factors as age at first breeding, length of reproductive cycle, interval between parturitions, litter size, lifetime productivity and mortality. It is therefore of interest to compare tne relative abilities of both species to produce biomass, a portion of which is sold for profit as meat. Table 1 produces the results of this comparison. It is evident that although the average live weight of adult does or ewes is about the same, litter size is a most important determinant of biomass production when other factors such as the level of husbandry and mortality rates are similar. In this case, goats produced about 82% more biomass than sheep in Malaysia.

(Table 1 here)

V FEEDING AND NUTRITON

Attention to feeding and nutrition, and the development of suitable strategies that can alleviate the prevailing low efficiency of production represents a particularly important strategy. Once the production objectives have been defined, and the appropriate choice of species has been made, the efficiency with which the production

resources are used and the response of the species to this efficiency, will be largely dictated by the level of feeding and nutrition. In this context, the attention to feeding and nutrition is the most important single factor that affects production, including reproductive efficiency. While breeding and selection programmes are necessary long term, the benefits of improved feeding and nutrition are spectacular and relatively immediate. It is relevant therefore to consider this topic in some detail.

The justification for emphasising feeding and nutrition is seen in two sets of results :

(a) India

Table 2 summarises the results of the effects of varying the plane of nutriton on two breeds of goats over three to five lactations. In both breeds, the differences in the average milk yield per lactation between the high and low planes of nutrition were very high and between 226 - 315%. It is significant to note that with the low plane of nutrition, the effect was to curtail milk production.

(Table 2 here)

(b) Malaysia

A comparison of adult goats of approximately similar ages from the rural areas and those reared "under" experimental conditions gave very high differences. The differences in live weight at slaughter, hot-carcass weight, dressing percentage, weight of meat, total edible weight and total saleable weight in favour of the experimental animals were 53.8, 79.1, 7.1, 47.3, 36.8 and 34.1% respectively. Table 3 summarises the results.

(Table 3 here)

The following strategies are considered important :

1. Increased Utilisation of Crop Residues and Agro-industrial By-products

More intensive use needs to be made of large amounts of lignocellulosic materials and other agro-industrial by-products, simply because these are the cheapest and most widely available feeds for ruminants. This conclusion has also been previously emphasised (F.A.O., 1982; Mahadevan, 1982). For successful application, acceptable feeding systems are those that are simple, practical, within the limits of farmers' capacity and resources availability, convincing and consistently reproduceable. Moderate to low levels of animal performance may be biologically inefficient, but could be more economically viable than high levels of performance especially with existing limitations of small farm systems.

Not enough use is being made of the various crop residues, agro-industrial by-product feeds to feed both goats and sheep. This is possibly due to inadequate use of intensive feeding systems such as that which has been successfully demonstrated for rice by-products or maize by-products fed with Leucaena leucocephala in the Philippines (Rasjid and Perez, 1980; Magay, 1982) and sugarcane by-products fed to goats in Fiji (Hussein et al.,1983).

2. Increased Forage Cultivation on Available Land

Where possible, there needs to be increased cultivation of forages, grasses and legumes on available land. This can be undertaken in any waste or uncultivated land, rice bunds and fence lines. The use of leguminous forages like leucaena (L. leucocephala) or sesbania (Sesbania grandiflora) is under-estimated and very much more use can be made of these especially as supplements (Devendra, 1984). The former is the most widely used forage for feeding ruminants in South East Asia (Devendra, 1986b) and provides an excellent source of fodder and

dietary nitrogen even during droughts and can also be used as a good fence line. The presence of such forage reserves form an important component of integrated agriculture in small farms and go a long way towards furnishing much needed nutrients to enhance intake and animal performance.

Throughout the Asian region, there exist a variety of tree leaves whose use is underestimated, especially for feeding goats. Table 4 summarises the names of these, and their value especially for goats has been emphasised (Devendra, 1983a).

(Table 4 here)

The basic strategy is to produce sufficient amounts of feed of good quality that are available all the year round, (Devendra, 1986c). On small farms, the demand for food crops supercedes production of feeds for livestock. Thus, innovative measures are needed for meeting nutrient requirements of livestock from various forages and residues from food crop production. This approach also has the associated advantage of enabling seasonal surpluses for example, cereal straws or silages, to be preserved for use subsequently, when feeds are in short supply such as during the dry seasons and droughts.

3. Increasing the use of dietary nitrogen sources

Associated with the first two strategies is the important need to concurrently increase the use of dietary nitrogen sources, especially non-protein nitrogen (NPN) sources and also proteinaceous forages. Examples of the benefits of using this is seen in the results from two separate studies in tables 5 and 6.

In the study of Winugroho and Chaniago (1983) goats were fed untreated and urea-ammonia treated straw supplemented with cassava leaves in Indonesia (Table 5). The inclusion of up to

50% cassava leaves with treated or untreated rice straw while stimulating increased weight gain, was not statistically different between treatments over 9 and 13 weeks experimental durations. It follows that the inclusion of cassava leaves to untreated rice straw is obviously cheaper than that of treated straw. It was concluded that grinding and urea-ammonia treatment of rice straw enabled goats to maintain weight. However, the inclusion of cassava leaves in diets with untreated and treated rice straw enabled pelleting of the feeds and for the goats to gain weight.

(Table 5 here)

The second study involved feeding of another example of feeding a proteinaceous leguminous forage, leucaena leaves, in balance trials with sheep. Increasing levels of leucaena forage (10 - 60%) were used to substitute the basal rice straw feed. Dry matter intake (DMI), crude protein and energy digestibilities and N retention were all improved. The increase in ME intake on account of leucaena supplementation ranged from 16.2% with the 10% inclusion to 86.2% for the 50% leucaena leaf inclusion (Table 6). N retention also increased with increasing leucaena level and as maximum for the 40% level of inclusion; the latter was concluded to be the optimum level.

(Table 6 here)

Concerning NPN sources, much more use can also be made of urea and poultry litter, both of which are relatively cheap and are within reach of farmers. It has been estimated there is an annual production of approximately 13.1×10^6 kg poultry litter, equivalent to 3.2×10^2 kg crude protein in Asia and the Pacific (Devendra, 1985c). A good proportion of this can also be incorporated in diets for goats and sheep.

Increasing the use of NPN sources can be achieved by employing one of several methods appropriate to a particular situation. Some of the methods applicable are as follows :

(i) Spraying to pasture
(ii) Spraying or addition to hay
(iii) As a liquid in a trough in association with molasses
(iv) As a block lick
(v) Inclusion in drinking water
(vi) Additive in cereals or concentrates.

Of these, the incorporation of urea into cereal straws to release ammonia or spraying of ammonia directly into the cereal straws, and the use of urea-molasses block licks (UMBL) has had considerable success. These two innovations are significant in that they represent two major success stories in Asia.

The value of UMBL is associated mainly because of their attractiveness and taste to livestock. The blocks are a potentially effective means of making NPN such as urea (15-20%) continuously available, fortified with macro and micro minerals and other nutrients, essential to both the microbes and the animal. The possibility of over-ingestion of the block and the danger of toxicity appears to be remote.

Much of the early work in this connection has been confined to buffaloes and cattle in India, the Philippines and Indonesia. Recently however, an attempt has been made to extend the use of UMBL to small ruminants and the three preliminary experiments of Soetanto (1986) in Indonesia are possibly the first of its kind. In experiment 1, the results of digestibility studies with sheep given waffered sugarcane tops (WST) with or without UMBL with 0, 3 or 6% urea and 500g leucaena, indicated that there was an increase in the dry matter disappearance *in sacco* of waffered sugarcane tops. The results were however not significant. In

experiment 2, four growing lambs were placed on each of three treatments : Control (+ 300g fish meal), WST + UMBL (3% urea) and WST + UMBL (6% urea). The results indicated that UMBL stimulated live weight gain which were significant (Table 7). Experiment 3 was similar to that as experiment 2 and used goats instead. However, it was terminated due to ill health of the goats. These preliminary studies suggest that the use of UMBL can also be extended to goats, especially in extensive situations where the feeds are coarse and also sparse. This strategy needs to substantially expanded in terms of future effort.

(Table 7 here)

4. Strategic Use of Supplementary Protein Sources

Strategic use of protein supplements, often the main limiting factor in efficient feeding and nutrition of ruminants also merits some considerations. Its economic use for both goat meat and mutton production needs to be carefully considered especially in relation to breed type and the potential for growth. With milk production however, judicious supplementation is necessary ensuring that the value of the milk produced is higher than the cost of the supplements used.

The importance of the decision to supplement is seen in the results of a recent study in India. The treatment involved feeding either green forage, concentrates or green forages + concentrates to a control browsing situation. Treatments as would be expected, significantly stimulated daily live weight gains and also affected dressing percentages ($P/0.05$). The net returns indicated that the supplementary feeding with forages gave the highest margin of profits followed by concentrates and finally the combined effect (Table 8). The results emphasise on the one hand the value of green forages, and question of the necessity for feeding concentrates for meat production from sheep in this experiment.

(Table 8 here)

The strategy to use scarce concentrates carefully implies that protein concentrates like coconut cake, groundnut cake, soyabean meal, palm kernel cake and fish meal, all of which are commonly found in most countries can be conserved and preferentially utilised more efficiently by non-ruminants animals. Some of these ingredients may even need to be protected for local use rather than be exported.

VI EXPLOITING THE AVENUES OF PRODUCTION

Three main types of production systems have been previously described (Mahadevan and Devendra, 1985). Of these, exploiting systems integrated with tree cropping appears to have potential possibilities of substantially increasing productivity from goats or sheep.

There currently exists in South and South East Asia according to F.A.O. (1984) data, 20.3 million hectares of land under permanent crops. This area is essentially unused and is potentially valuable if some of it can be integrated with either goats or sheep for meat production using the available knowledge and by suitable interventions. Assuming an average stocking rate of 4 goats or sheep/ha which is typical for stocking rates involving natural vegetation under coconuts and rubber based on a review of the literature (Devendra, 1985b), and even if only half this land area (10 millions ha) was integrated with one of the species, the corresponding number of goat or sheep equivalents is 40 millions. At an approximate slaughter weight of 20 kg, the potential biomass production is 800,000 tonnes, which represents about 79% of the combined current production of goat meat and mutton from goats and sheep in South and South East Asia. It is patently clearly therefore that the avenue of production can be exploited much more fully and merits high priority in research and development programmes.

Likewise, a system which can also be investigated more fully is intensive stall feeding or the cut-and-carry system. The system is also favoured by increasing demographic pressures, reduced grazing land and the presence of quite considerable quantities of crop residues and agro-industrial by-products, including non-conventional feeds. The available crop residues and non-conventional feeds are not being used adequately in intensive feeding systems and this needs to be substantially expanded.

With both systems in particular, and all systems in general, there needs to be multi-desciplinary effort and application of the information that is already on hand. These can be brought to bear in order to achieve the final objective of maximising productivity from both species.

VI EXPORT MARKETS

A major initiative that requires attention and one which has not been given the attention it deserves, is the question of export markets for goat meat and mutton. Admittedly, the first priority is to maximise production of meat from both goats and sheep to meet national targets. However, consideration can also be given to markets beyond national boundaries, and especially in the Near East. This market potential is enormous and awaits urgent initiative. This initiative needs to consider the following aspects :

1) Type of meat required (goat meat and or mutton)
2) Methods of slaughter, processing and transportation
3) Live animals or frozen carcasses,
4) Aspects of carcase quality and taste preferences, and
5) Economic benefits of the export trade.

These considerations, and the quest to increase productivity from small ruminants through more intensive systems of management encourage yet another aspect of the production system which has not been adequately considered in the past : commercialisation of large scale meat production comparable to beef enterprises. This aspect has not

been given the attention it deserves to take advantage of the available dietary ingredients, and thus merits much more research and development. The inherent advantages of this approach include more complete utilisation of the available feeds, the development of more intensive systems of production including better use of especially the meat breeds, and expanded production of meat in quantitative and qualitative terms for both the national and especially international markets in the Near East.

Some consideration has already been given towards meeting this objective especially in Pakistan and India, but further progress needs to be sustained. In the former case, large sheep feed lots are now being examined in Buluchistan and the North West Frontier Province using mainly non-conventional feeds such as depathogenised poultry litter, concurrent with the development of slaughter facilities. Such initiatives can conceivably also be expanded to include other countries in Asia, provided the production resources can be coupled to economic meat production from small ruminants. Perhaps the overriding consideration in this initiative is the element of urgency that is required to grasp the existing demand potential in the Near East. Once this initiative has been grasped, it will be necessary to sustain production and strive towards improving the quality of the meat produced to meet consumer preferences.

VIII INFRASTRUCTURE, RESEARCH, LINKAGES AND TRAINING

Strong infrastructure is essential to support research and development programmes. Continuing research is vital to sustain progress not only nationally, but regionally, in which linkages can promote further progress. Large scale on farm testing is also necessary, and for the results to be accepted, they must be within the limits of the farmer's capacity and resource availability, are convincing and consistently reproduceable. Inherent with all these strategies is suitable training to ensure effectiveness of the total effort.

One aspect of the support services that needs revamping in many countries concerns the extension services. Often the application of useful knowledge is impeded by inadequate extension services. Adequate extension services are an integral part of all development programmes, including disease diagnosis and animal health provision, sale, marketing arrangements, producer and marketing cooperatives.

IX CONCLUSIONS

There clearly exist a number of possible strategies that can be employed to increase productivity and hence the potential contribution from small ruminants. Some of these are clearly more important than others and therefore justify urgent attention. In this category are definition of production objectives, reproductive efficiency, improved nutritional management, and exploiting the avenues of production. Of these, the highest priority needs to be given to exploiting more completely, systems integrated with tree cropping. Potential possibilities of how improvements can be achieved are discussed which can make a significant impact on production.

It has been reported (TAC, 1985) that the projections for the demand for sheep and goat products up to the year 2000 indicate that the gap between production and consumption is increasing faster than for other food commodities. This conclusion is presumably based on current trends in the population growth rates, and prevailing patterns of consumption of the meats produced from both species. This trend is likely to result in an increased population size in the year 2000 by about 29% goats and 21% sheep (Table 9). If on the other hand, innovative improvements can be urgently made to focus on the more potentially important production systems such as integration with tree cropping involving the 20.3 millions ha under permanent crops, the population of both species can be increased by about 66 - 86% from the base year in 1986. This increase can make a major impact on food production and also significantly alleviate the prevailing low levels of production.

(Table 9 here)

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TABLE 1

COMPARATIVE BIOMASS PRODUCTION BETWEEN INDIGENOUS GOATS AND SHEEP IN MALAYSIA

(Devendra, 1985b)

Species	Av. live weight of female	Litter Size	Survivability at 12 mths[+]	Av. weight at slaughter (kg)	Biomass production[++] (kg)
Goats	22	1.8	1.44	20	28.8
Sheep	22	1.1	0.88	18	15.8

[+] Mortality rate is 20%

[++] Survivability x av. slaughter weight

TABLE 2

EFFECTS OF NUTRITION ON LACTATION MILK YIELDS OF TWO DAIRY BREEDS OF GOATS (BARBARI AND JAMNAPRI) IN INDIA (Sachdeva et al., 1974)

	Barbari			Jamnapari		
Lactation number	(MH)[a]	(LL)[b]	Difference	(HH)[c]	(LL)[b]	Difference
	----(liters)----		(%)	----(litres)----		(%)
1	101.0	27.8	263.3	153.7	44.0	249.3
2	129.7	30.3	328.1	196.0	58.4	235.6
3	100.4	21.7	362.7	131.8	45.2	191.6
4	106.8	...	...	128.0	...	...
5	109.2	...	...	...	...	...
Mean	110.4	26.6	315.0	160.5	49.2	226.2

[a]Medium-high plane of nutrition.
[b]Low-low plane of nutrition.
[c]High-high plane of nutrition.

TABLE 3

MAGNITUDE OF IMPROVEMENT FEASIBLE IN INDIGENOUS KATJANG GOATS FROM RURAL AREAS DUE TO IMPROVED NUTRITIONAL MANAGEMENT IN MALAYSIA (Devendra, 1979)

Parameter	Rural goats[1]	Experimental goats[1]	Improvement feasible (Percentage)
Liveweight at slaughter (kg)	18.6	28.6	53.8
Hot carcass weight (kg)	8.2	14.7	79.3
Dressing (Percent)	44.2	51.3	7.1
Weight of meat (kg)	5.5	8.1	47.3
Meat:bone ratio	4.1	4.9	19.5
Forequarter (kg)	1.2	2.9	108.3
Hind leg (kg)	1.2	2.2	83.3
Total edible weight (kg)	13.2	18.2	36.8
Total saleable weight (kg)	17.9	24.0	34.1

[1]Adult goats about 3 years of age.

TABLE 4

SOME IMPORTANT TREE LEAVES AND BROWSE PLANTS
IN SOUTH AND SOUTH EAST ASIA

Common Name	Botanical Name
I. Bangladesh, India and Pakistan	
Anjan	Hardwickia binnata
Ardu	Ailanthus excelsa Roxb
Babul	Acacia arabica
Bauhinia	Bauhinia spp.
Banana	Musa spp.
Bargad or Banyan	Ficus bengalensis
Beri	Ziziuphus jujuba
Dhaincha	Seshania aculeaton
Gular	Ficus glomerata
Imli	Tamarindus indica
Jackfruit	Artocarpus heterophyllus
Jamun	Engeinia jambolana
Kheiri	Prosopis cineraria
Khair	Acacia catechu
Khanthal	Artocarpus integrifolia
Mulberry	Morus indica
Pakar	Ficus infectoria
Pipal leaves	Ficus religiosa
Neem	Azadirachta indica
Sainjan	Moringa oleifera
Siras	Albizzia lebbeck
II. Indonesia, Malaysia, Philippines and Sri Lanka	
Banana	Musa spp.
Banyan	Ficus bengalensis
Canna	Canna spp.
Cassava	Manihot esculenta Crantz
Gliricidia	Gliricidia maculata
Hibiscus	Hibiscus Rosa-sinensis
Ipil-ipil	Leucaena leucocephala
Jackfruit	Artocarpus heterophyllus
Lantana	Lantana spp.
Passion fruit	Passiflora edulis f. flarcarps
Pigeon pea	Cajanus cajan
Singapore rhododendron	Melastoma malabathricum

TABLE 5

EFFECT OF FEEDING UNTREATED AND UREA-AMMONIA TREATED GRAND RICE STRAW ON THE AVERAGE DAILY GAIN OF YOUNG GOATS

(Winugroho and Chaniago, 1983)

Treatment+	Live weight gain, (g/day)	
	9 weeks	13 weeks
75 URS : 25 CL	53[a]	45[a]
50 URS : 50 CL	91[b]	92[b]
75 TRS : 25 CL	93[b]	84[b]
50 TRS : 50 CL	105[b]	101[b]
100 TRS	11[c]	27[a]
SE	10.3	10.4

+ URS - Untreated rice straw,
TRS - Treated rice straw,
CL - Cassava leaves.

[abc] Means on the same columns with different superscripts differ (P less than 0.05).

TABLE 6

INTAKE AND DIGESTIBILITY OF CHOPPED RICE STRAW (RS) SUPPLEMENTED WITH VARYING LEVELS OF LEUCAENA LEAVES (Devendra, 1983)

Parameter	RS (Control)	RS + 10% L[++]	RS + 20% L	RS + 30% L	RS + 40% L	RS + 50% L	RS + 60% L
Fresh intake, g/day	741.3a	890.7ab	967.7ab	1158.7ab	1446.0bc	1475.7bc	1300.7bc
DMI/$kg^{0.75}$, g/day	59.9a	58.9a	53.2a	59.9a	68.5b	70.7b	59.9a
DMI as, % body weight	2.7a	2.6a	2.6a	2.8a	3.1a	3.1a	2.7a
DM digestibility,	42.4a	48.5b	46.7b	49.5b	50.5b	53.2c	49.6b
OM digestibility,	50.9a	51.3a	49.5a	52.5b	53.3b	55.5b	52.4b
CP digestibility,	19.7a	40.5b	47.2c	49.6c	52.0c	66.2d	50.5c
Energy digestibility,	40.4a	46.4b	46.3b	52.1c	51.5c	54.7c	46.2b
N retention, as % of intake	-0.1a	20.2b	16.4b	23.6b	31.5c	27.5c	30.8c

[++] RS - rice straw, L - leucaena leaves.

[abc] Means on the same row with different superscripts differ (P less than 0.05).

TABLE 7

THE EFFECT OF UREA-MOLASSES BLOCK LICKS SUPPLEMENTATION ON FEED INTAKE AND DAILY GAIN OF LAMBS IN INDONESIA (Soetanto, 1986)

Diet	DM Intake (g/d)		OM Intake (g/d)		Daily live weight gain (g/day)
	WCT++	UMBL+++	WCT	UMBL	
A+	224.94	88.74	186.27	81.07	-35.40
B	236.64	91.81	209.57	83.87	18.57
C	283.27	116.69	234.15	106.47	23.60

+A - Natural grass ad lib + 300 g fish meal
B - UMBL + 3% urea
C - UMBL + 6% urea
++WCT - Waffered sugarcane tops.
+++UMBL - Urea-molasses block licks.

TABLE 8

PERFORMANCE OF WEANER KIDS IN A SEMI-ARID ENVIRONMENT IN INDIA

(Parthasarathy, Singh and Rawat, 1983)

Parameter	Browsing (B)+	B + forage	B + concentrates	B + forage + concentrates
Initial weight(kg)	12.0	10.9	12.7	12.5
Final weight(kg)	13.8	14.7	22.8	22.3
Weight gain(kg)	1.8	3.7	10.0	9.7
Av. daily gain(g)	19.4	41.7	111.0	108.2
Dressing %	45.7	44.5	48.2	49.1
Net returns (Rs/kid/90 days)	-	9.0	3.6	0.2

+ For 7 hours daily.

TABLE 9

PROJECTED GOAT AND SHEEP POPULATIONS IN SOUTH AND SOUTH EAST ASIA AND THE SOUTH PACIFIC (10^6)

Category	1984[+]	1986[++]	2000[++]	2000[+++]	% increase*
Goats	136.2	142.0	183.7	236.3	66.4
Sheep	73.2	75.2	90.8	140.1	86.3

[+] FAO (1984).

[++] Based on annual growth rates of 2.1 and 1.5% for goats and sheep respectively.

[+++] Potential increase due to integration of goats and sheep with permanent crops (Please see text for explanation).

* From the base year 1986.